HELIUM HUNTING IN MONTANA

Robert H. Springer
Springer Resources, LLC
Fort Worth, Texas

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Montana Technological University
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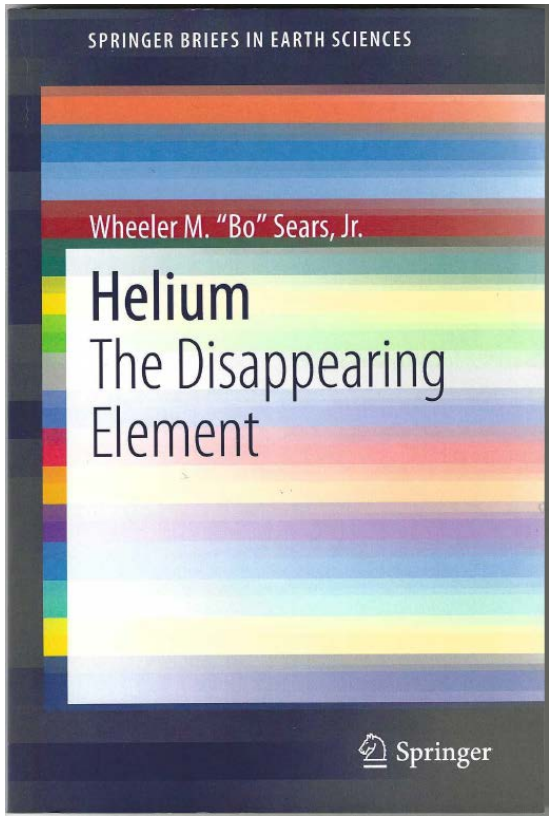
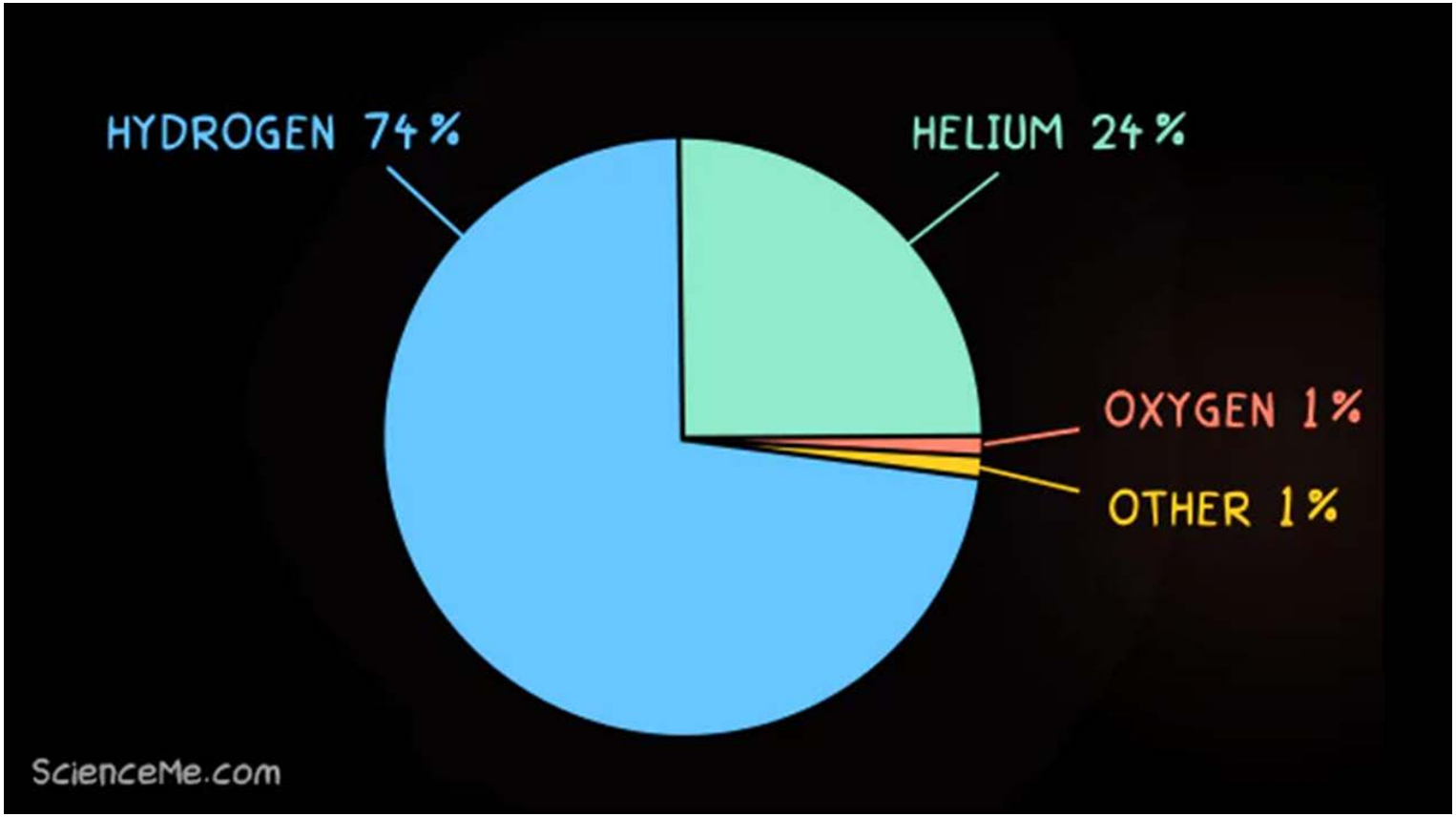
Thank You to Wheeler "Bo" Sears for recommending me for today's presentation and providing significant portion of the material presented. Bo has been known as a *"Helium Evangelist"* for over 30 years and is CEO of Helix Exploration which is listed on London Stock Exchange and is author of "Helium The Disappearing Element".



https://www.helixexploration.com

Why is the Helium "Disappearing"?

- Helium is 2nd most abundant element in the Universe, but is relatively rare on earth.



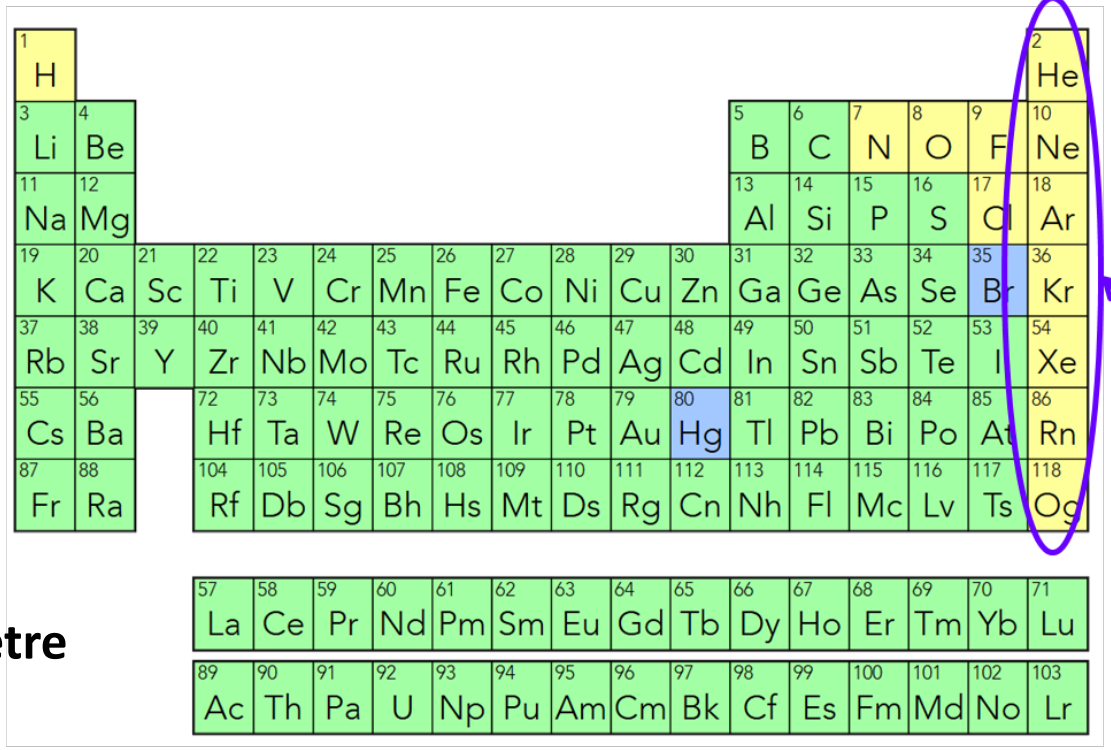
Why is the Helium "Disappearing"?

- Once the Helium is in the atmosphere it is Not Gravitationally bound to earth and is continually Lost To Space.
- **Low density :** Helium has a density of 0.1786 grams per liter at room temperature and pressure, making it lighter than air. *Fancy way of saying that's why balloons float and it gets lost to space.*

Why is the Helium "Disappearing"?

- Helium is the **Smallest Element**! *Hard to contain! Used to test vessels for leakage.*

289pm **260pm**



pm = pico-metre

Adapted from education.jlab.org – accessed 3/2025

Helium Properties

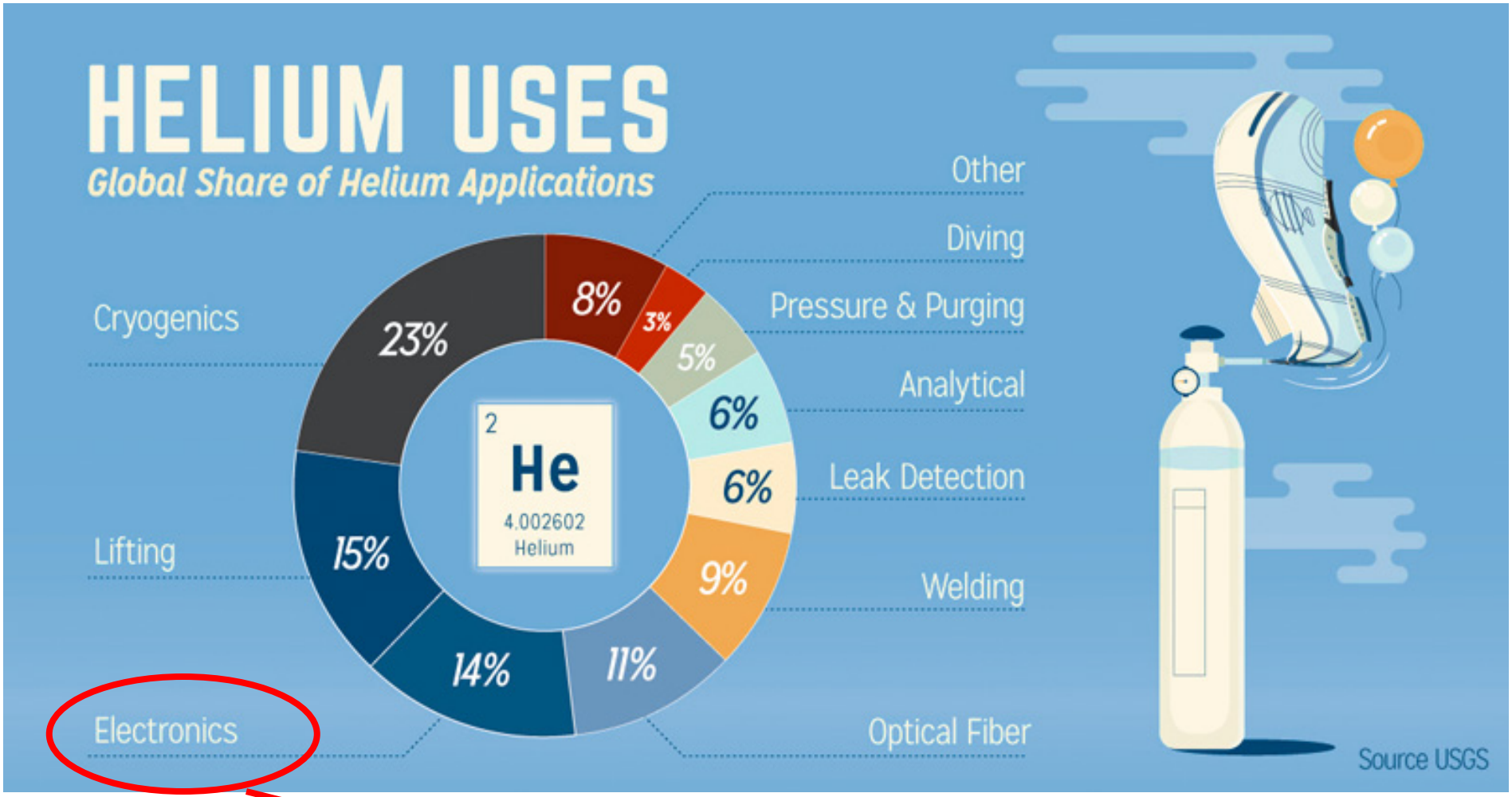
- **Chemically inert:** Helium is a noble gas, meaning it is unreactive and does not readily form chemical bonds with other elements. *This one of the reasons it fills the compartments when etching semiconductors with x-ray lithography to prevent alteration of the silicon chip.*

  It is used in welding aluminum to provide oxygen-free environment.

- **High thermal conductivity:** Helium is also a good conductor of heat.

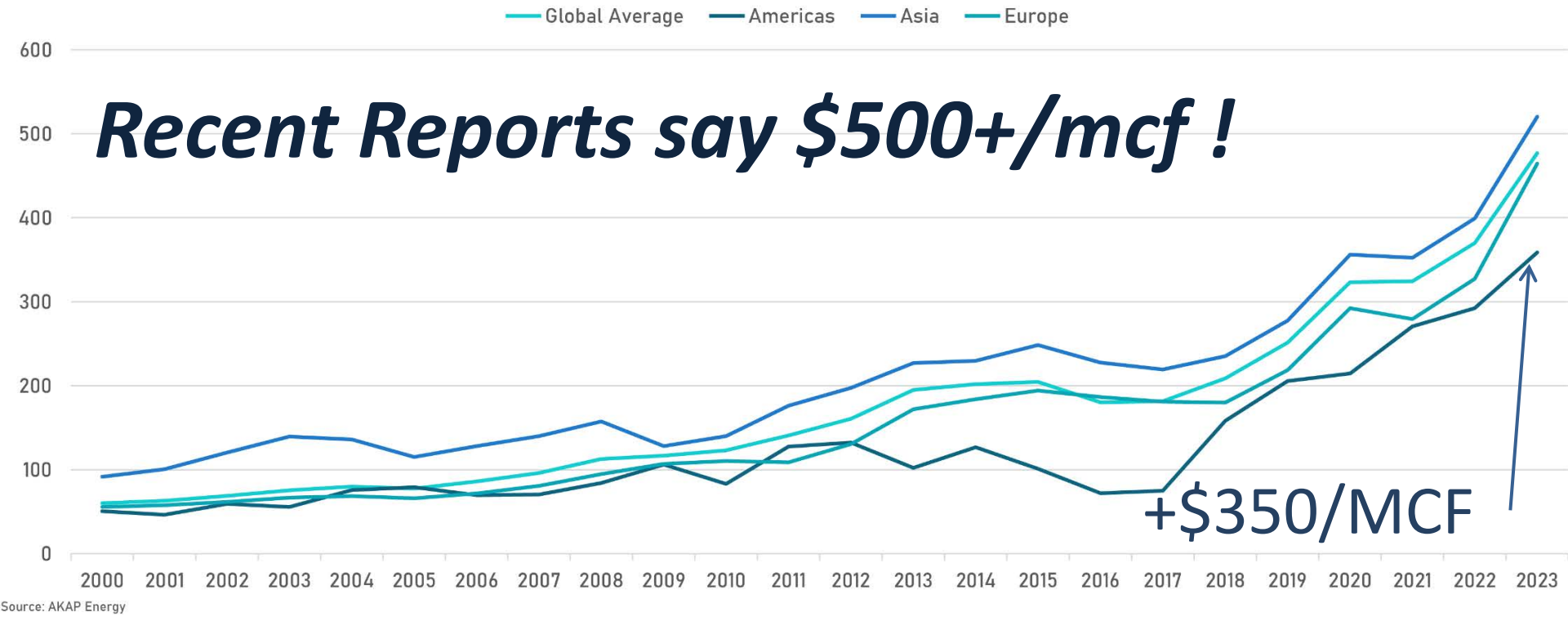
- These are just some of the many properties that make Helium *valuable*!
- ***The Need for Helium is Growing Rapidly!!***

Helium Uses



And Growing Fast with Semiconductors, Data Centers and AI

Why Montana?



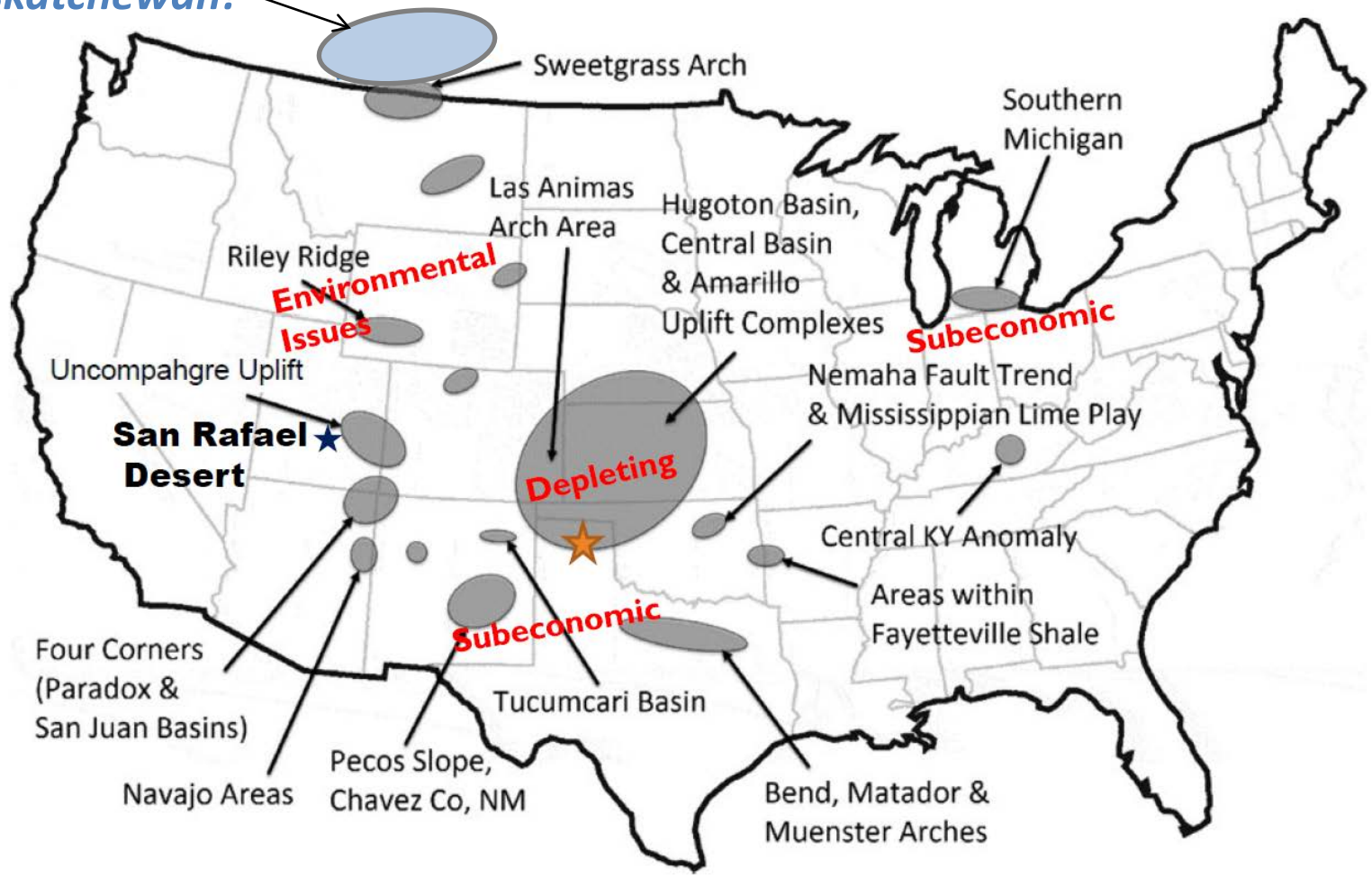
Only 5 large industrial gas companies are in the Helium market. Market prices are very opaque!

From Helix Exploration website –accessed 3/2025

Why Montana?

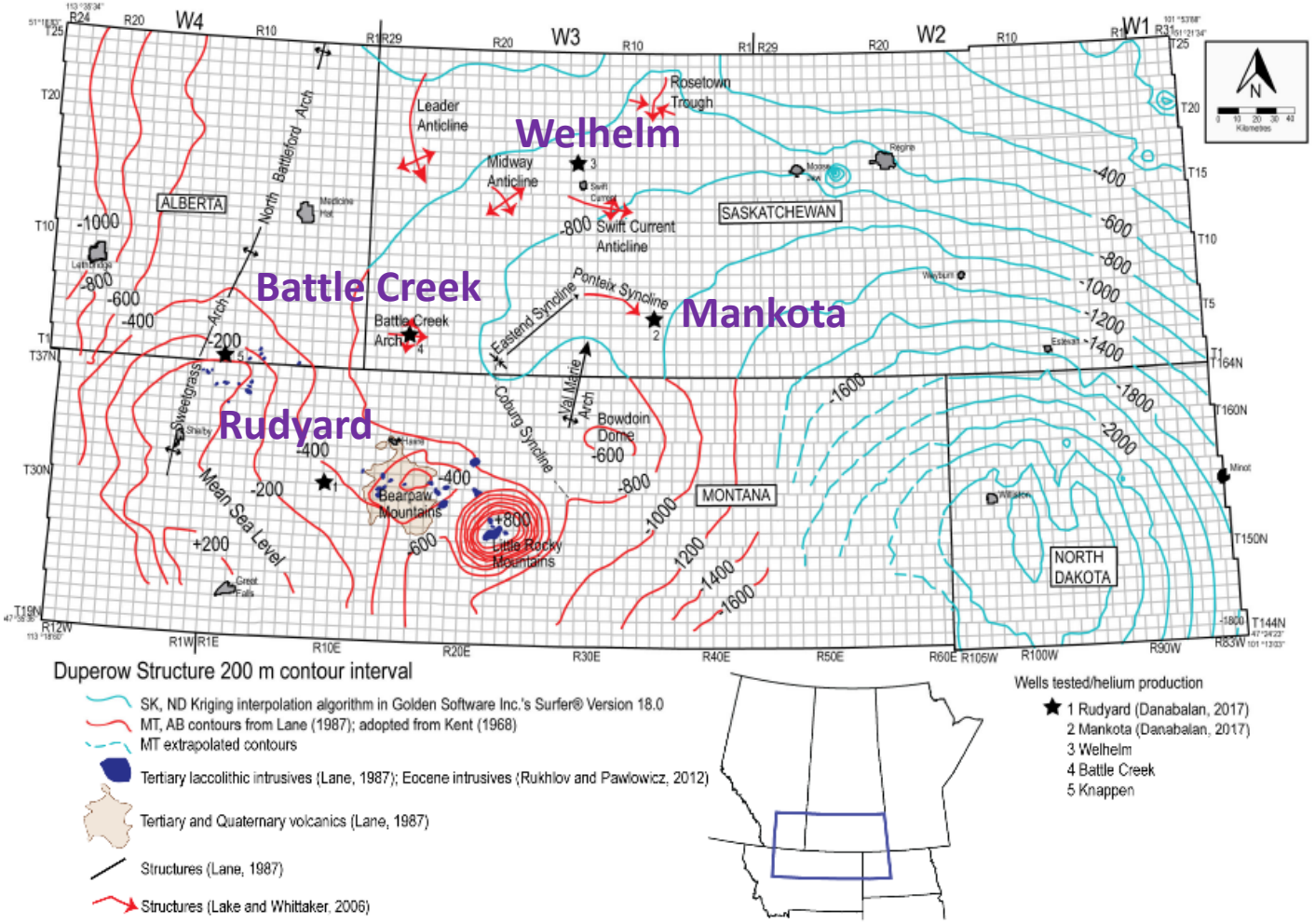
Helium occurrence found along eastern edge of the Rocky Mountains and western Mid-Continent

Recent New Production in Saskatchewan!



From Wiseman (2021) "Utah Helium Updates"

Why Montana?



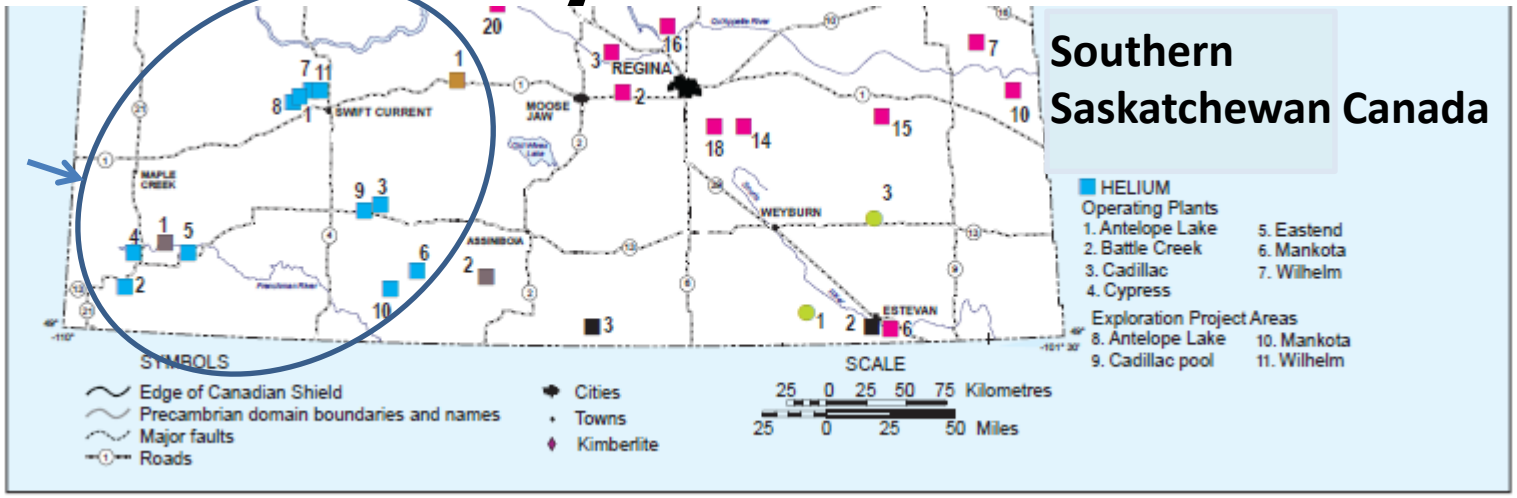
Mankota – Active areas in 2021

- Bo Sears was responsible for initiating activity at Mankota, first grade A Helium producer.

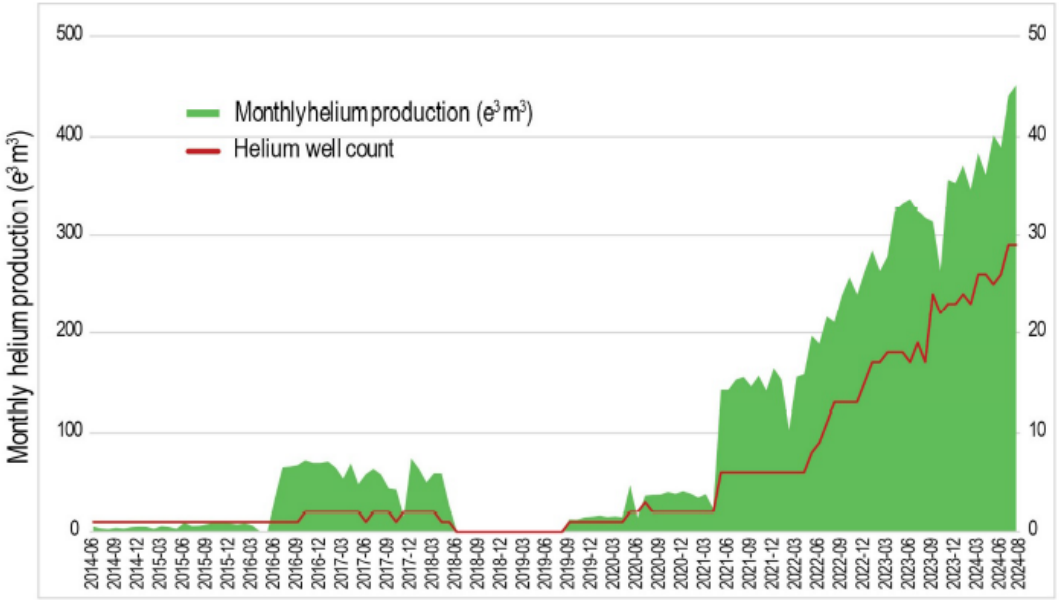
From Melinda M. Yurkowski (2021)

Why Montana?

Robust Helium Activity



- Since 2014, over 110 wells targeting helium resulting in 7 helium extraction plants by August 2024.
- Presently 31 wells producing over 4.4M m^3/ month.
- Estimated 2% of the worlds helium production.



Adapted from Saskatchewan Exploration and Development Highlights 2024

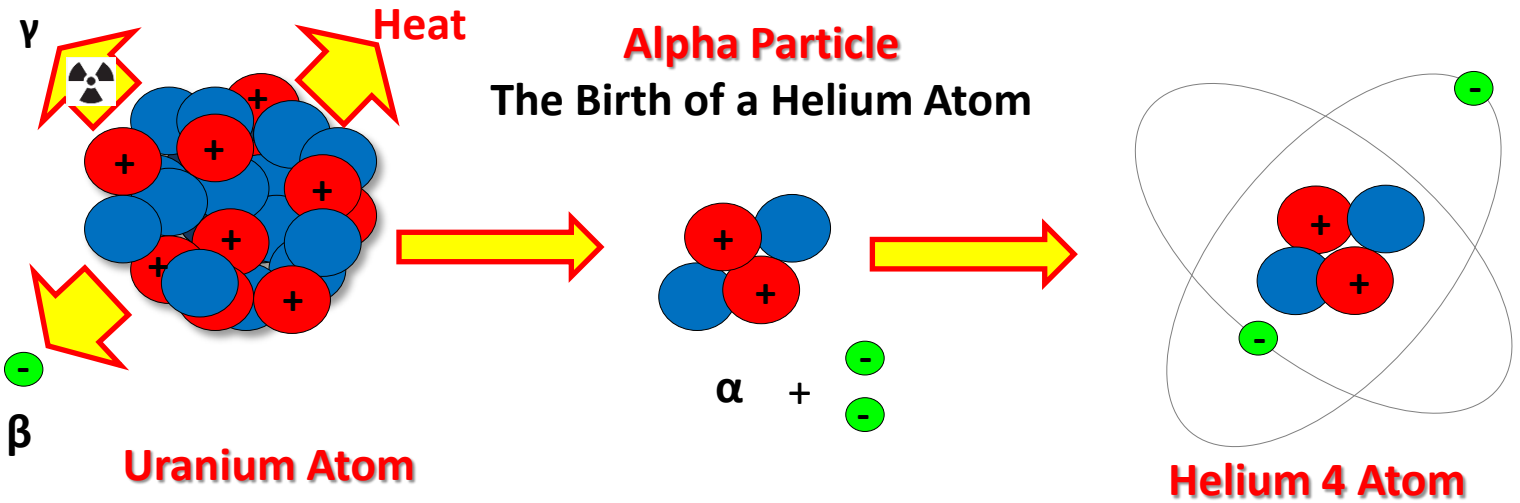
Why Montana?

- Montana has all of the necessary geological elements for commercial helium creation & entrapment.
- The necessary geological elements are much like oil & gas:
  - **Source Rock & Generation**
  - **Expulsion & Migration**
  - **Reservoir Rock**
  - **Trap & Seal**

Source Rock & Generation

Uranium-238

- ^{238}U represents 99.3% of all U isotopes found in nature
- Its half life is 4.5 billion years (4.5 Ga) –This is very important!!
- During its decay, the following particles are emitted
  - **Alpha** (a helium nucleus = 2 protons + 2 neutrons)
  - **Beta** (an electron)
  - **Gamma** (not a particle but rather a form of electromagnetic radiation like light or radio waves but with more energy)



An alpha particle is expelled from the nucleus of the unstable Uranium atom, where it eventually picks up two electrons for form a helium atom. In the process, this high energy expulsion creates heat and is responsible for much of the earths heat, causing convection cells, etc.

Slide created by Bo Sears.

Pitchblende

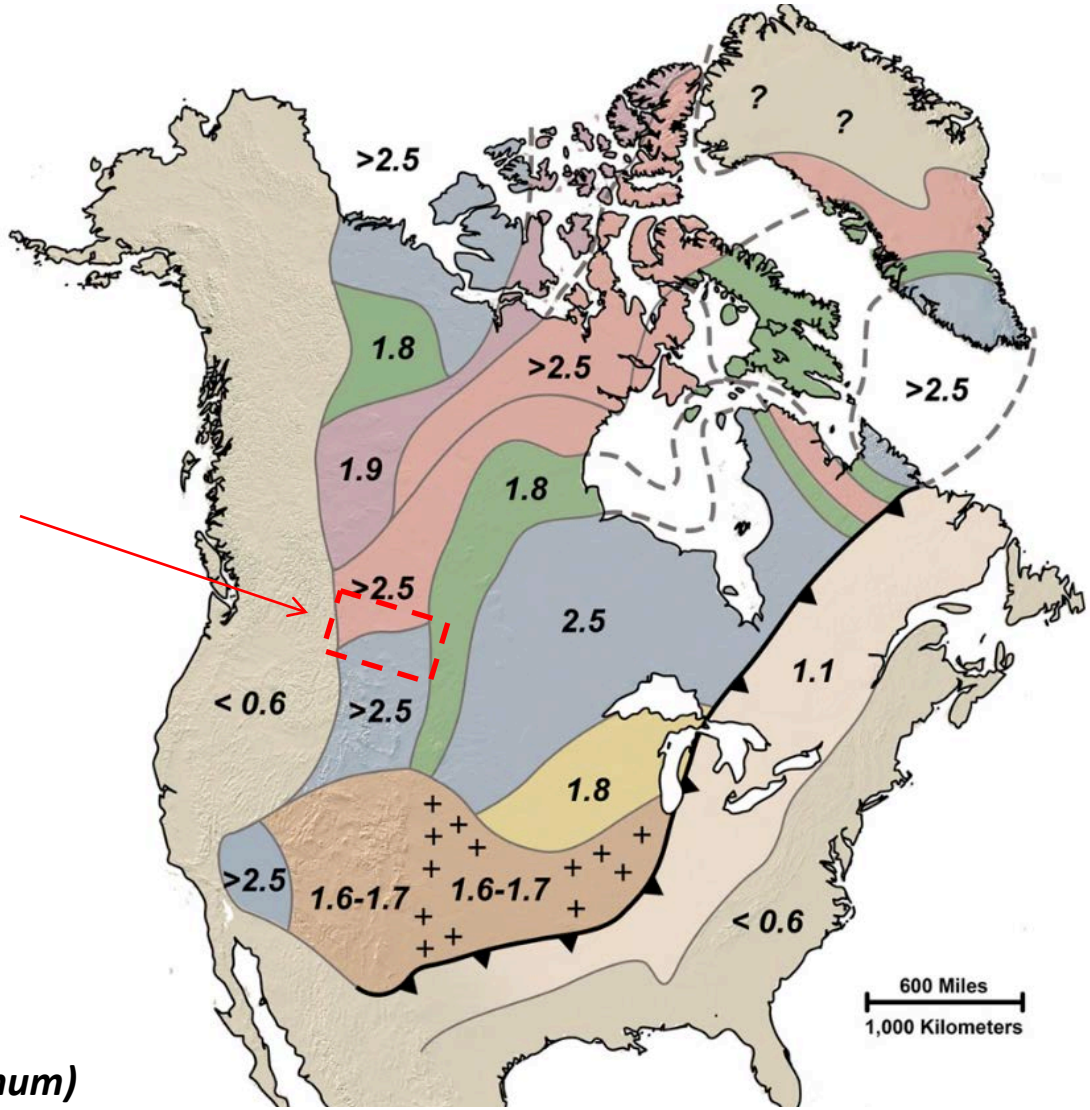
Pitchblende is just one of many Uranium-based sedimentary minerals on earth. As the Uranium decays in this mineral, the end product is a stable lead isotope.

Throughout the decay series, alpha particles are emitted as the nucleus becomes the next radioactive isotope down the list.

These alpha particles are helium nuclei. After two electrons are captured, a helium atom is born.

Symbol	Element	Radiation	Half-Life	Decay Product
U-238	Uranium-238	alpha	4,460,000,000 years	Th-234
Th-234	Thorium-234	beta	24.1 days	Pa-234
Pa-234	Protactinium-234	beta	1.17 minutes	U-234
U-234	Uranium-234	alpha	247,000 years	Th-230
Th-230	Thorium-230	alpha	80,000 years	Ra-226
Ra-226	Radium-226	alpha	1,602 years	Rn-222
Rn-222	Radon-222	alpha	3.82 days	Po-218
Po-218	Polonium-218	alpha	3.05 minutes	Pb-214
Pb-214	Lead-214	beta	27 minutes	Bi-214
Bi-214	Bismuth-214	beta	19.7 minutes	Po-214
Po-214	Polonium-214	alpha	1 microsecond	Pb-210
Pb-210	Lead-210	beta	22.3 years	Bi-210
Bi-210	Bismuth-210	beta	5.01 days	Po-210
Po-210	Polonium-210	alpha	138.4 days	Pb-206
Pb-206	Lead-206		stable	

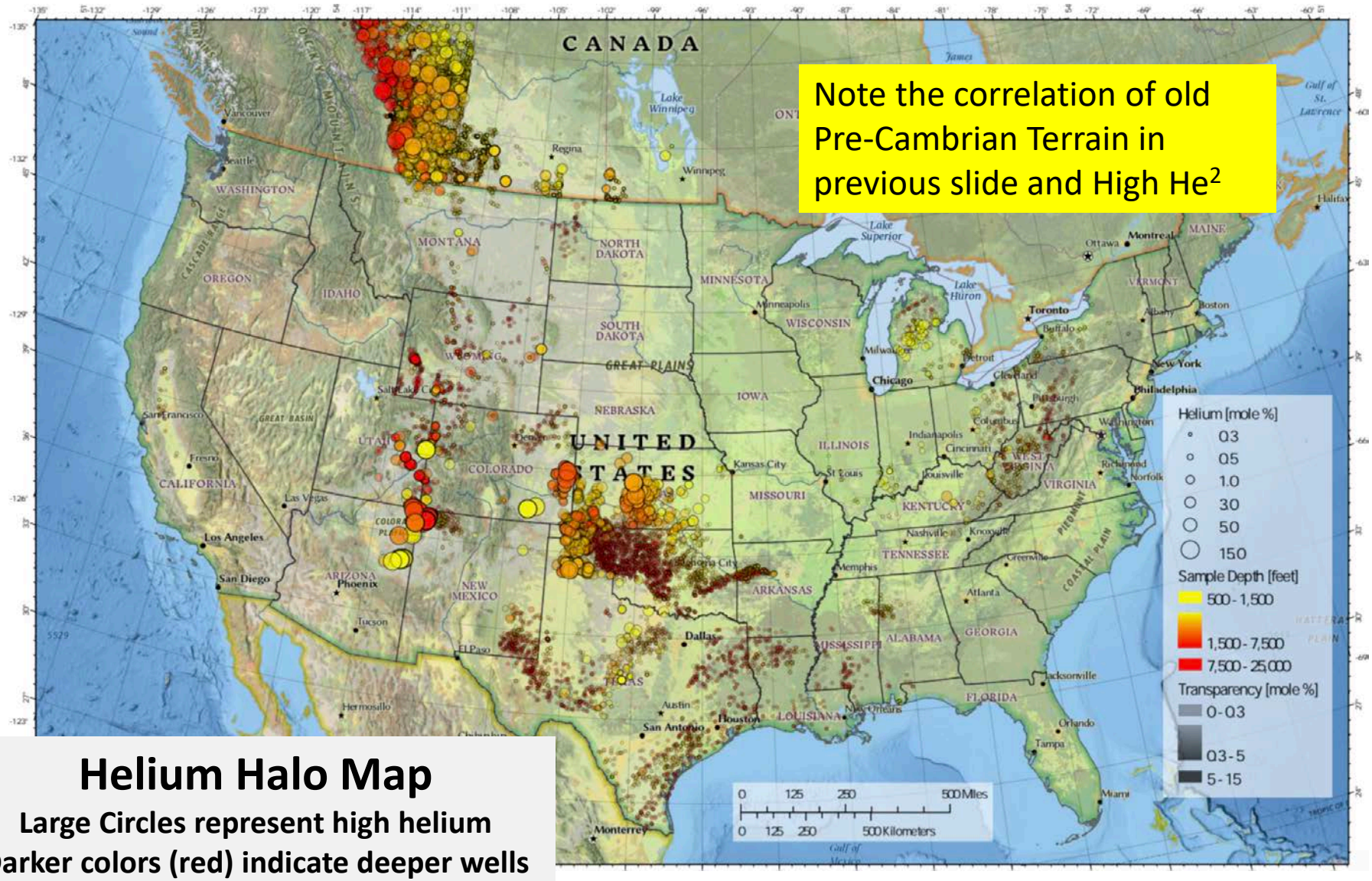
Source Rock & Generation



2.5 = 2.5 Ga (giga-anum)

Modified from S. Marshak (2001)"Earth: Portrait of a Planet"

Source Rock & Generation

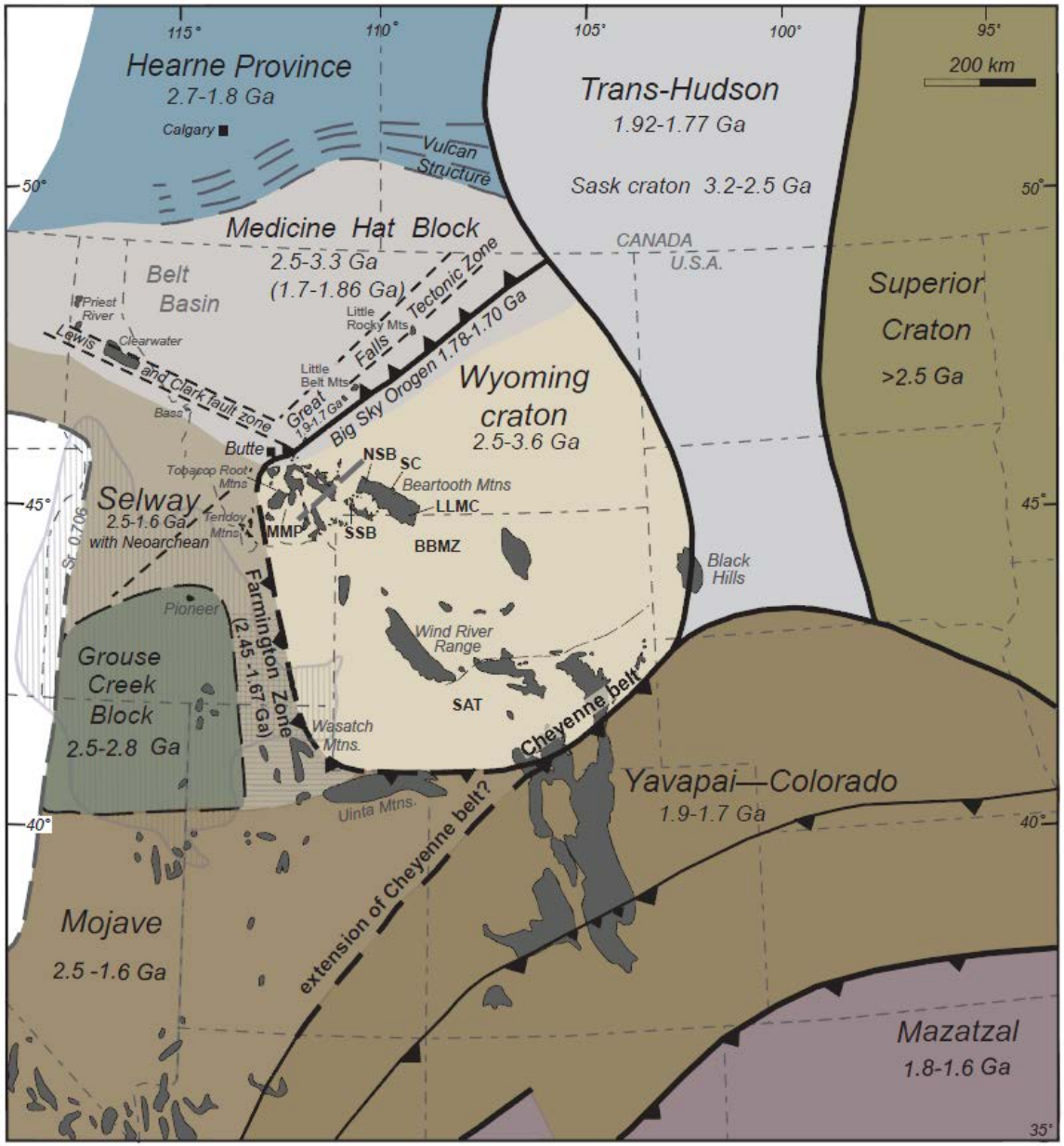


Helium Halo Map

Large Circles represent high helium
Darker colors (red) indicate deeper wells

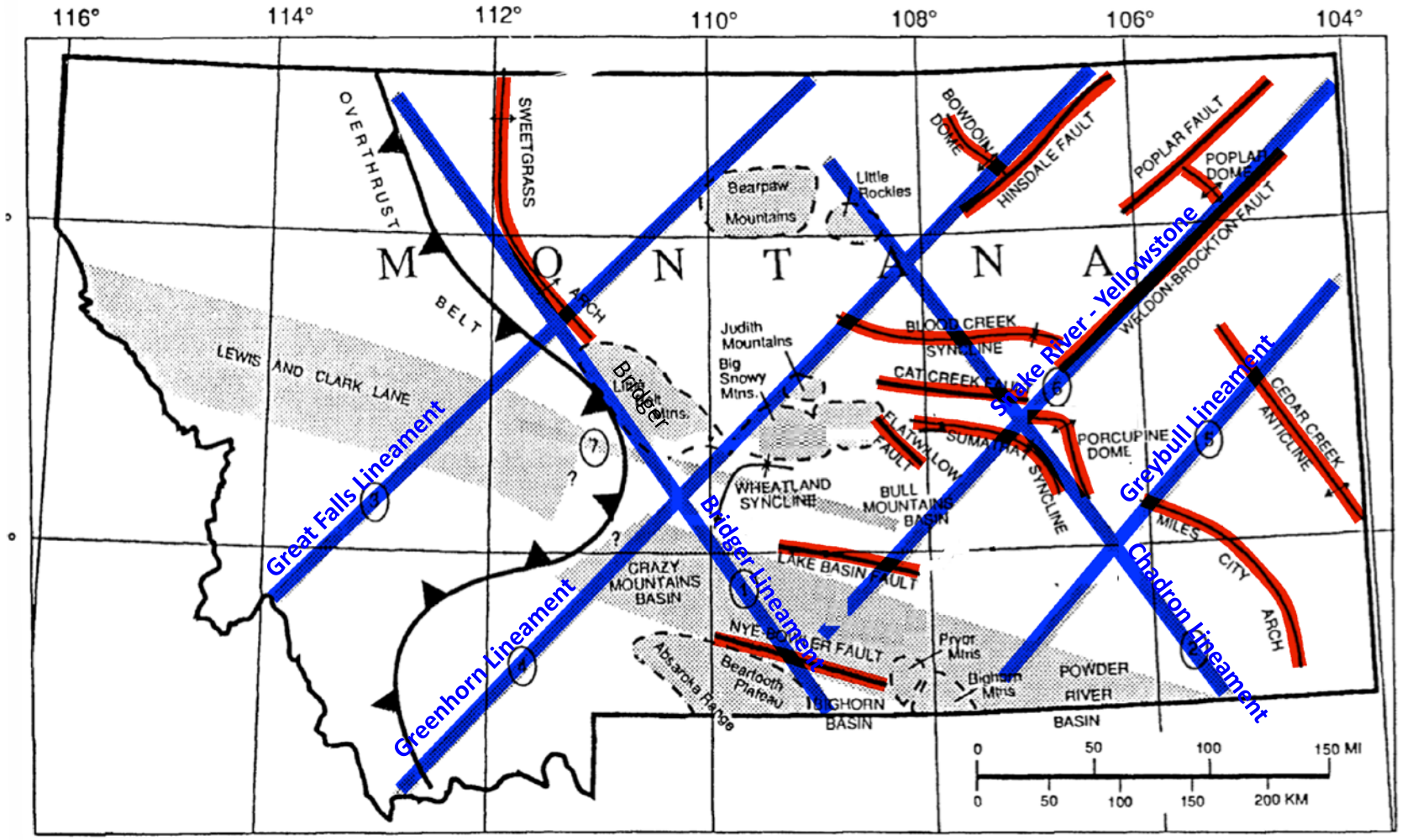
From Wiseman (2021) "Utah Helium Updates"

Source Rock & Generation



Adapted from S. Mogk, and others (2006)"The Archean Geology" MBMG SP121

Expulsion & Migration

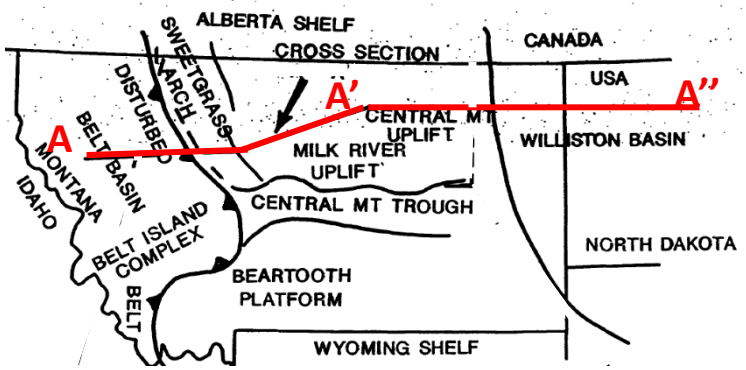


Principal Structural Features of Montana

Fractures as reflected by Lineaments provide the escape route to overlying reservoirs to be trapped.

Adapted From Maughan and Perry (1986)

Expulsion & Migration



- He[2] exited the Pre-Cambrian rocks migrating upward into the overlying sedimentary horizons.

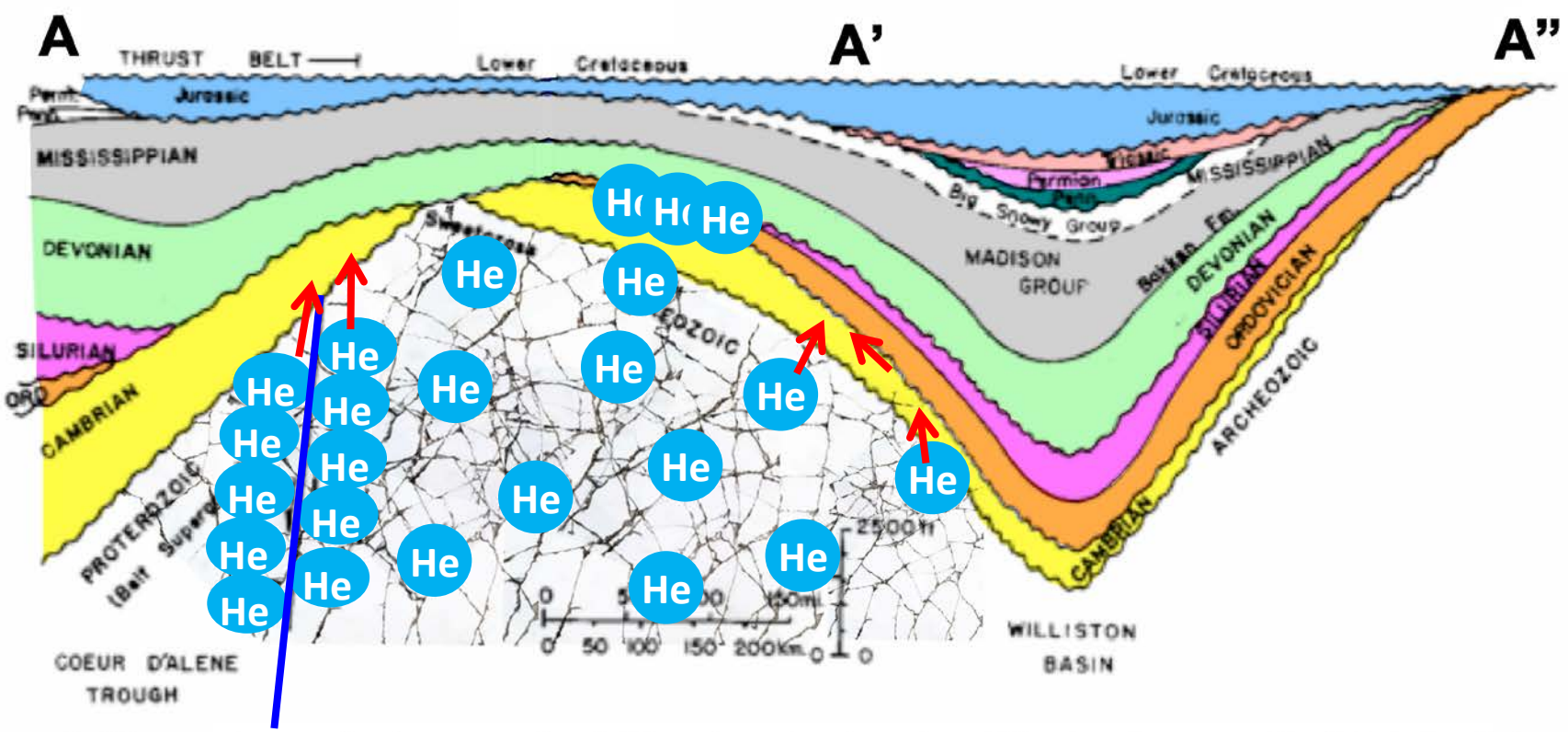
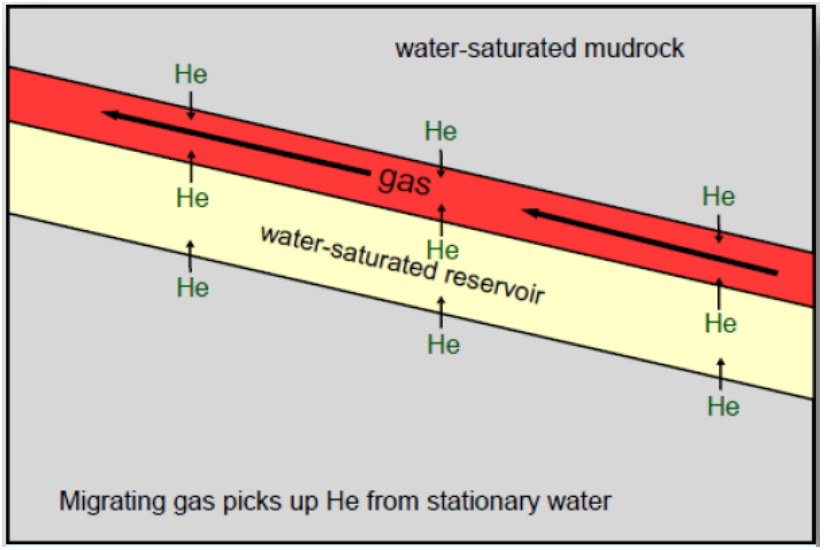


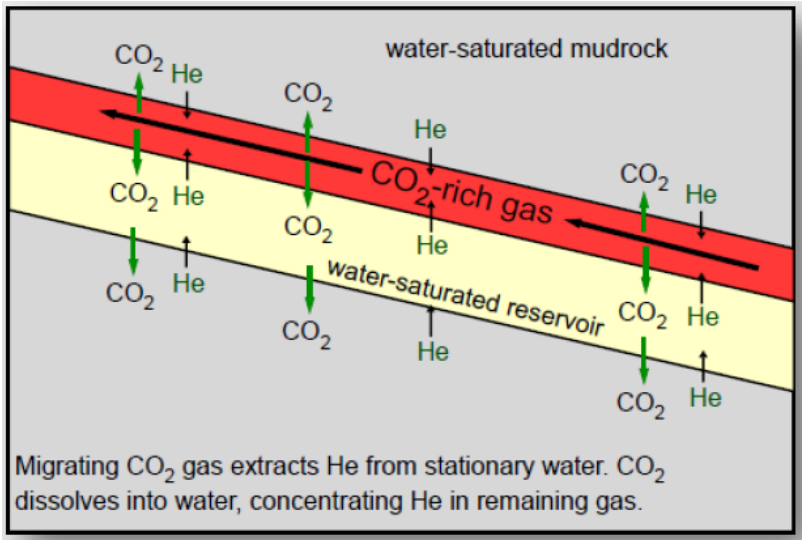
Figure 2. West-east generalized cross-section A-A", partly restored, northwest Montana to eastern North Dakota. Datum, top of Jurassic. Location of cross-section shown in fig. 1.

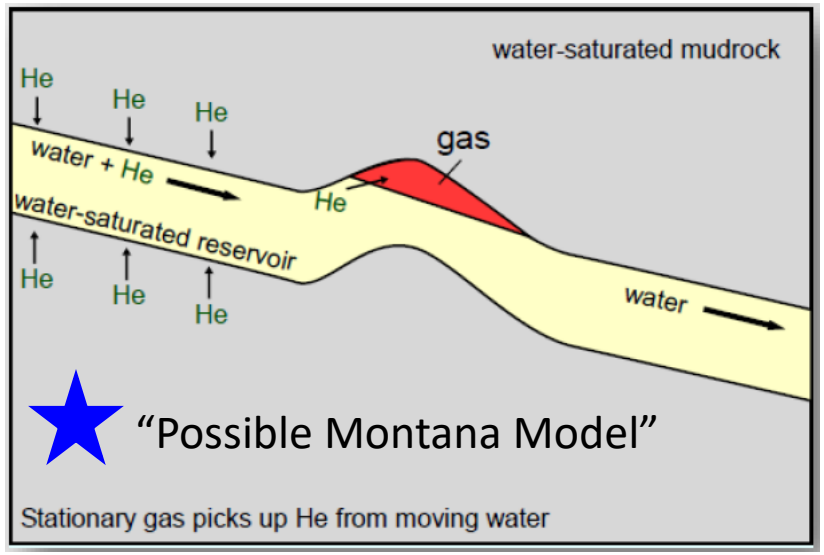
Location Adapted From T.S. Dyman (1987) Cross Section from James A. Peterson (1985) modified by Bo Sears

Expulsion & Migration

Must have moving fluid, either moving water or moving gas to concentrate He^2







He^2 is never alone, it is always found associated with another gas as a carrier. The most commonly associated carrier gases found are:

- **Nitrogen**
- **Natural Gas**
- **CO2**
- **H^2S**

Adapted From Wiseman (2021) and Brown (2010)

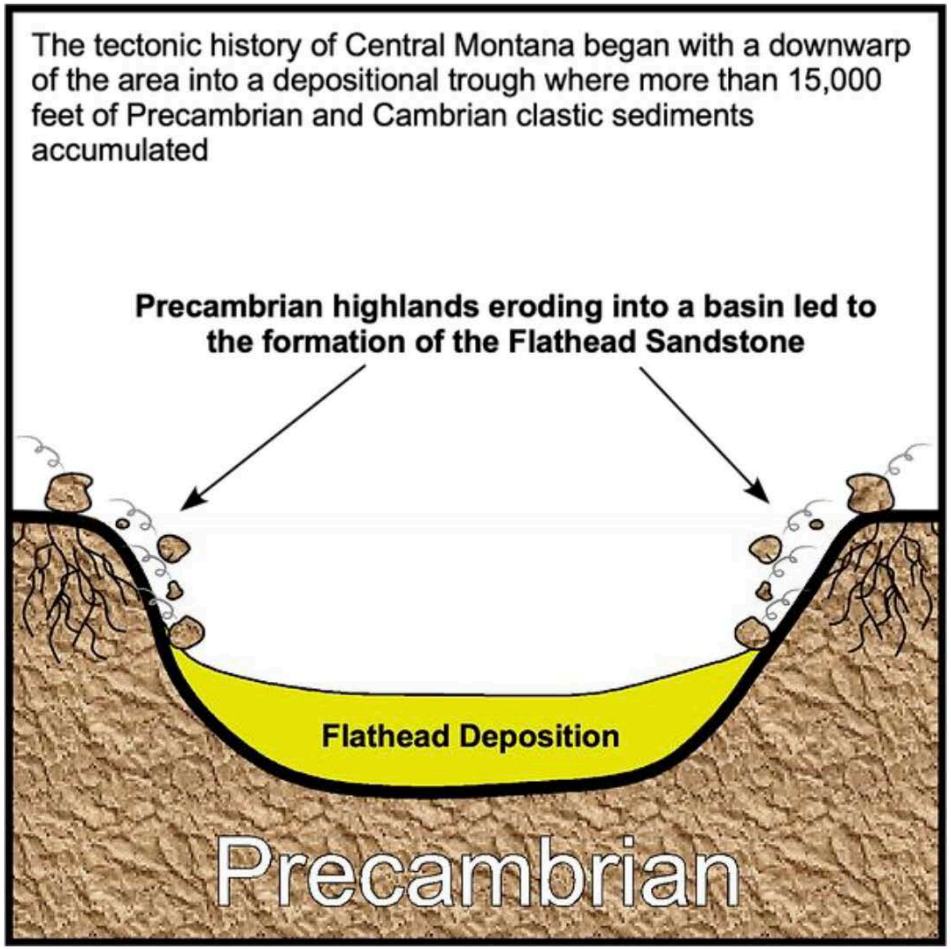
Reservoir Rock

Example of one of the many possible reservoir rocks.

Location is about 6 miles west of Cody, Wyoming eastside of Cody Mountain Tunnel looking south on US 14-16-20 .

Image from Google Maps Streetview accessed March 2025

Reservoir Rock

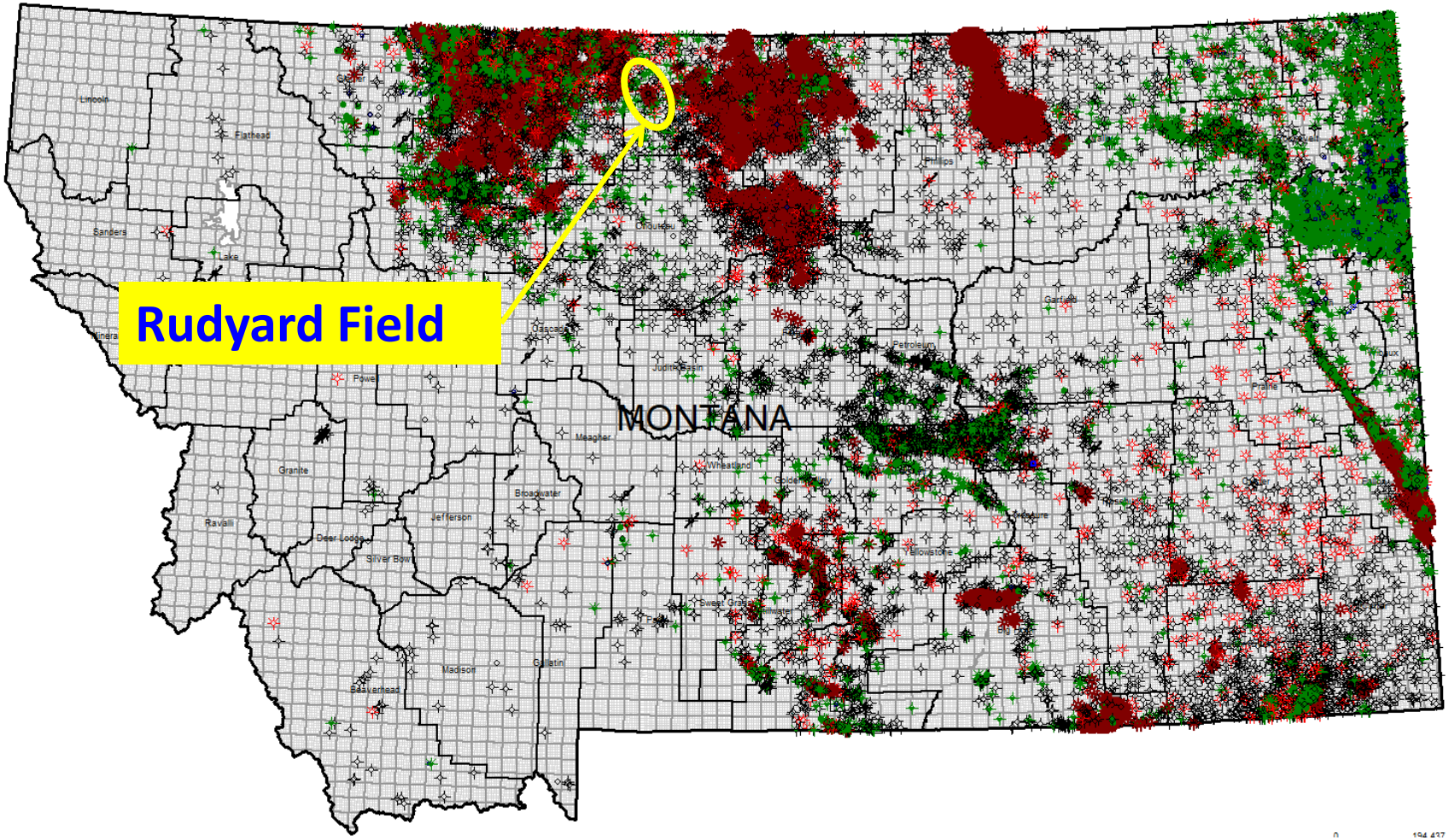


Deposition of Flathead sediments

Source Unknown

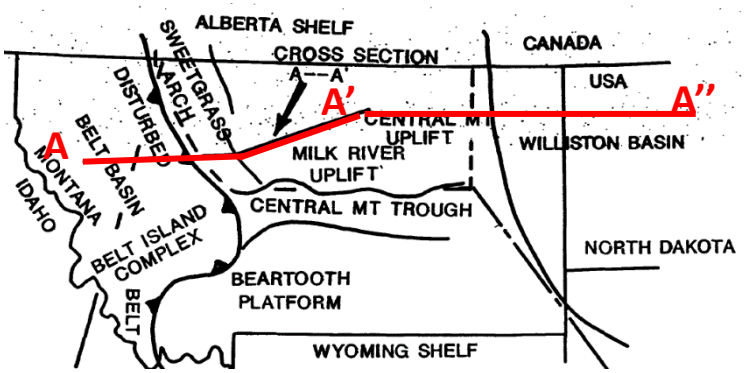
Trap & Seal

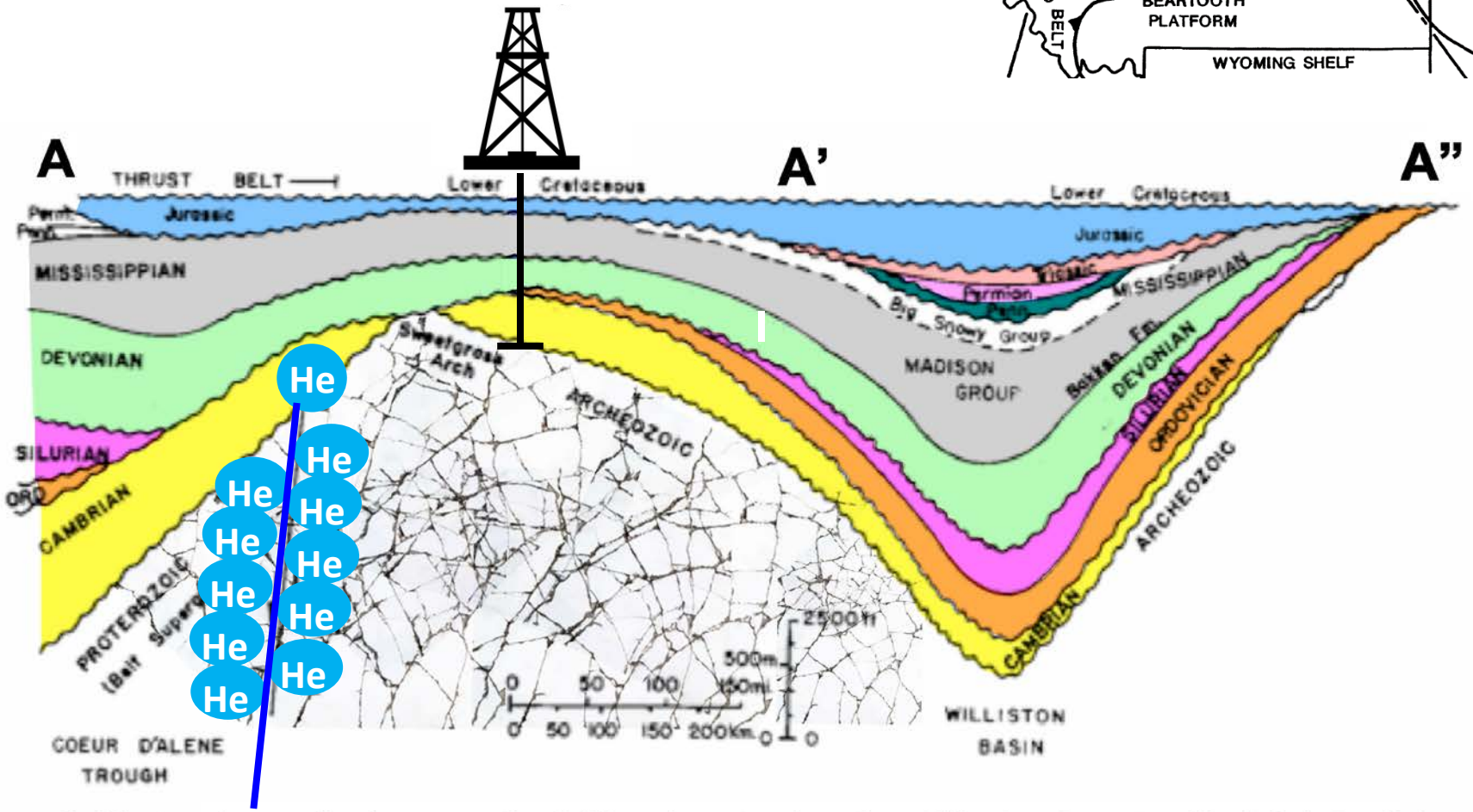
Example of Structure known to have Helium concentration.



Trap & Seal

Rudyard Field





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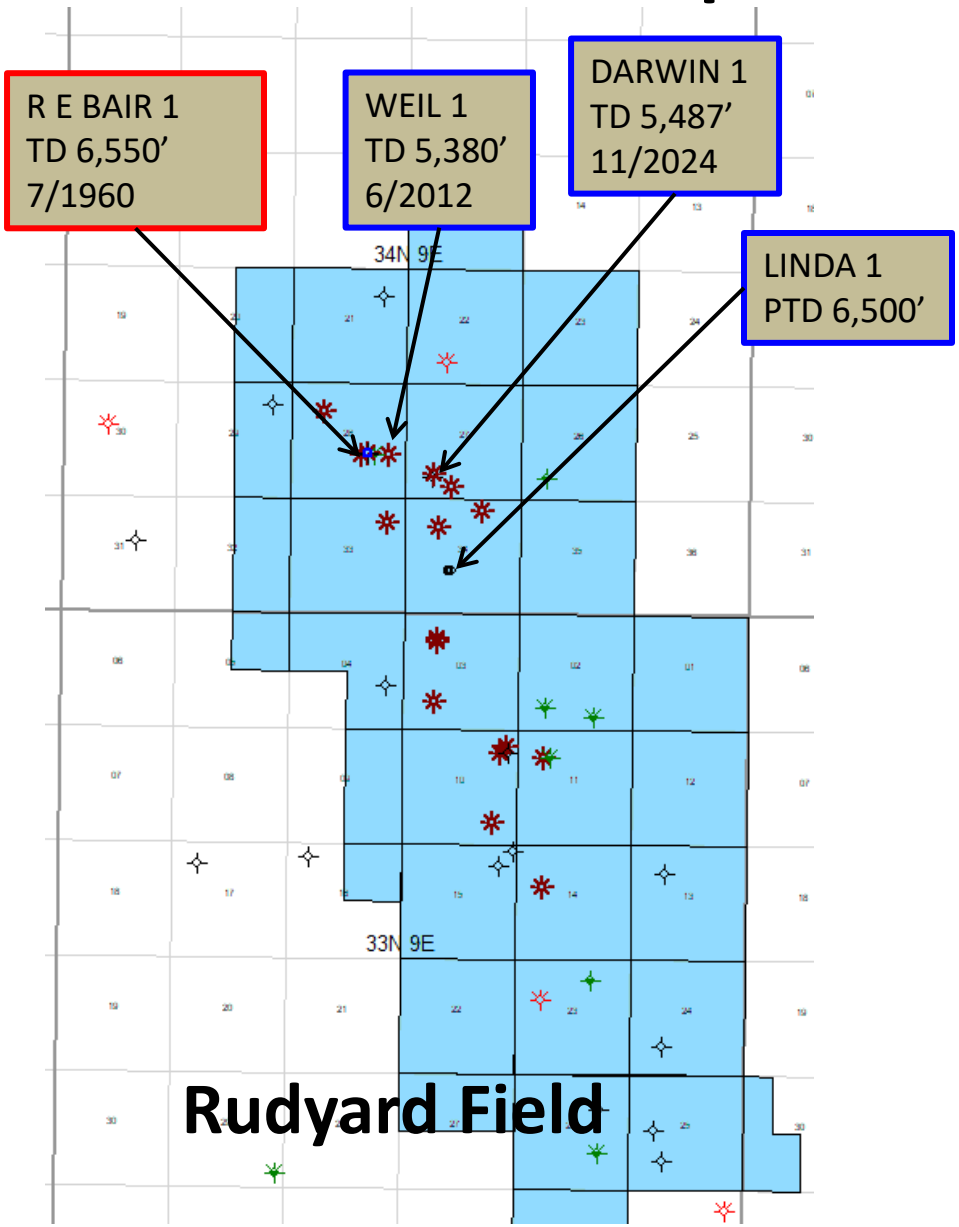
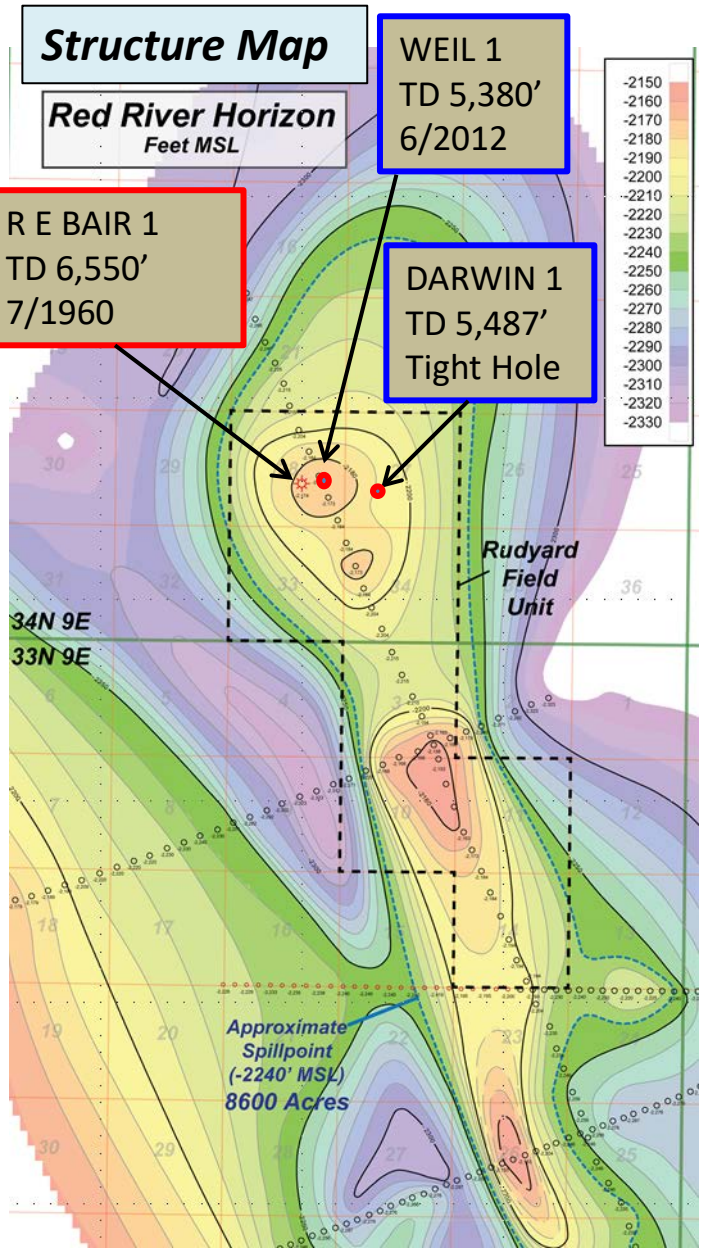
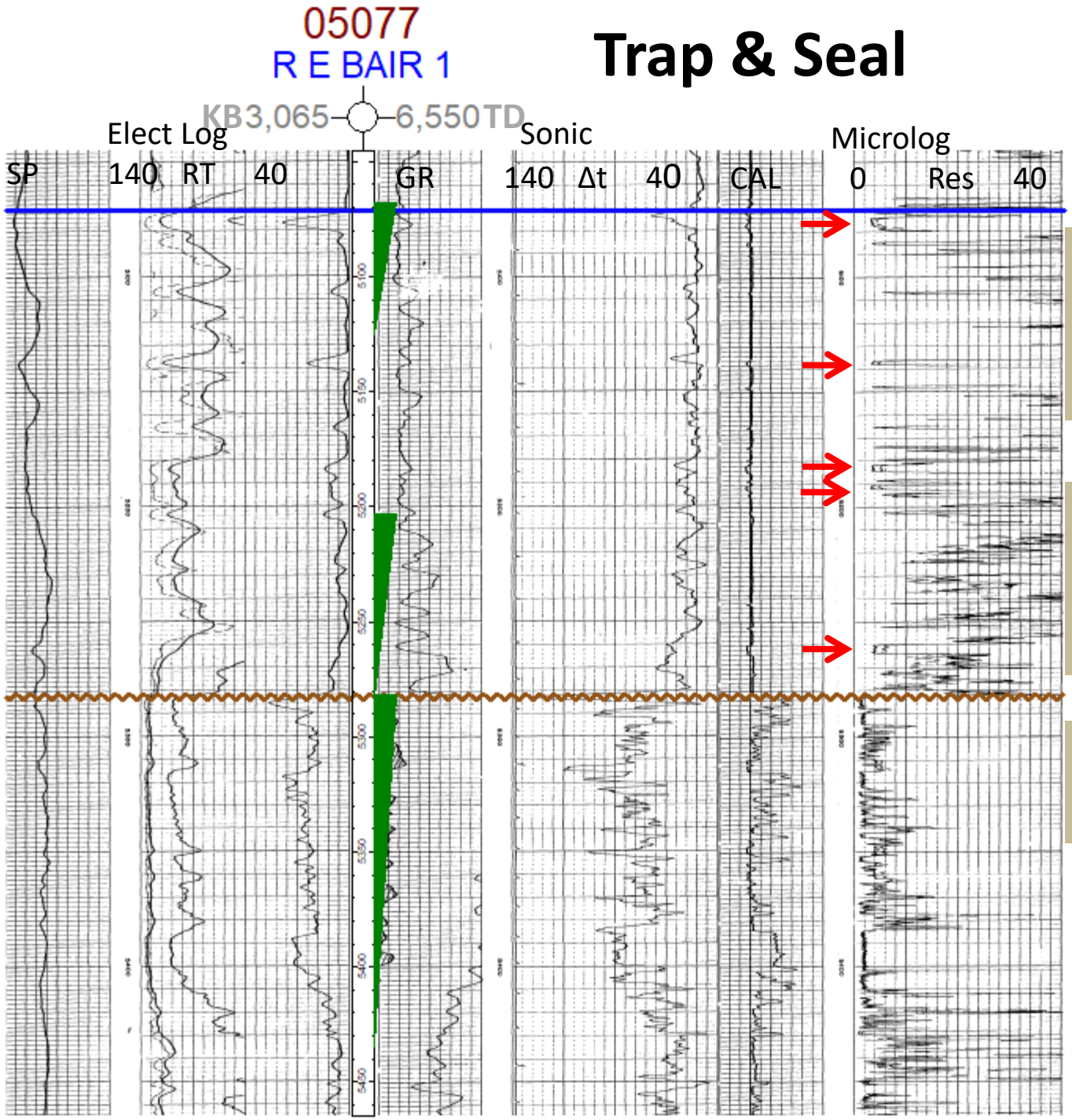




From Helix Exploration website –accessed 3/2025

Trap & Seal

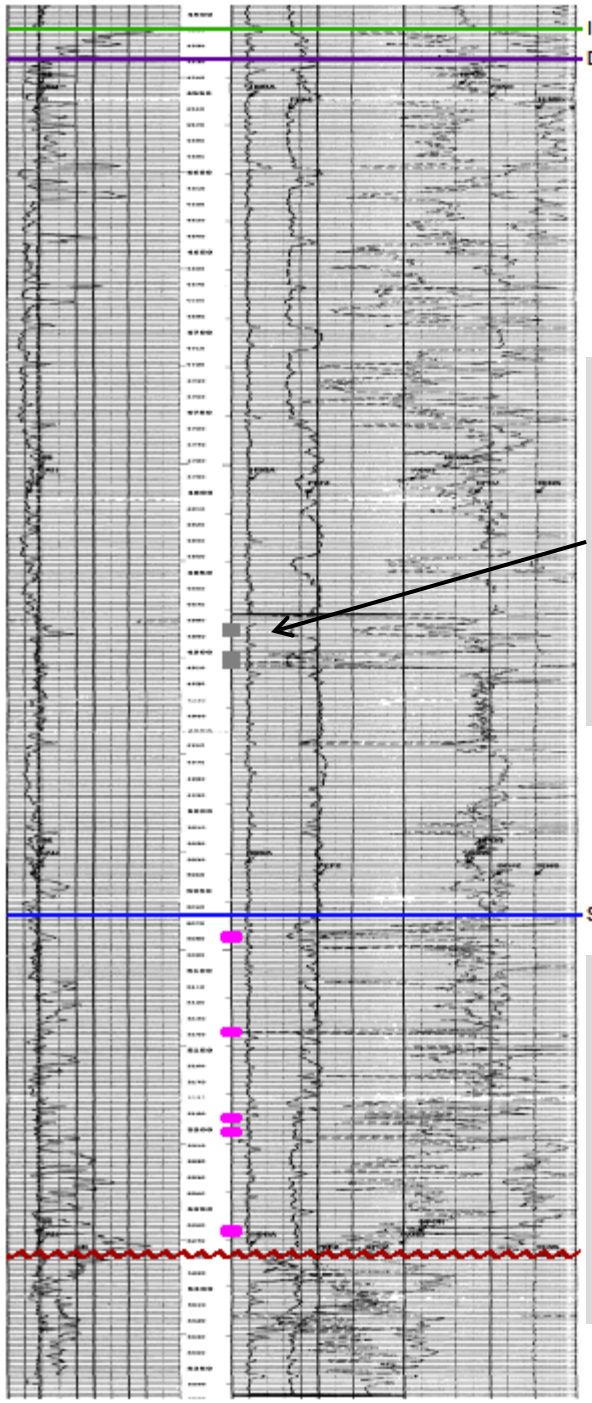


Drilled by Texaco in 1960!

DST: 5068-5125'Souris River
Rec: 85' Mud
1150 MCFGPD Non-Combustible Gas He 0.90%

DST: 5203-5283'Souris River
Rec: 320' Gas Cut Mud
3060 MCFGPD Non-Combustible Gas He 1.30%

DST: 5282-5435'Dry Creek Shale
Rec: 210' Mud (last 90' Gas Cut)



Trap & Seal

23548

WEIL 1 (Well Now Owned by Helix Exploration as of 2025)

3,064 — 5,380

Has not been produced yet.

7/2013
PF: 4882-89 & 4900-10' Duperow
A/ 500 gals 15%HCL Swbd 12 hours
R: 300 bbls Wtr w/ trace of oil
Perfs sqzd and drill out and returned to original gas completion.

6/2012
PF: 5076-5265' Souris River & Red River
A/ 1000 gals 15% HCL w/ 140 soluable bioballs
IPF: 2480 MCFGPD
FTP: 559 psi SITP: 1900 psi

Component	Chemical mol. %
Carbon Monoxide	nd
Hydrogen Sulfide	na
Helium	0.909
Hydrogen	nd
Argon	0.266
Oxygen	nd
Nitrogen	95.51
Carbon Dioxide	0.42
Methane	2.49
Ethane	0.129
Ethylene	nd
Propane	0.101
Propylene	nd
Iso-butane	0.0588
N-butane	0.0403
Iso-pentane	0.0340
N-pentane	0.0100
Hexanes +	0.0285

Trap & Seal

Log Not Shown –Tight Hole

Darwin #1

As per Dec. 12, 2024 Press Release :

· Darwin #1 confirms commercial helium discovery at Rudyard

· 236ft of Darwin #1 perforated simultaneously, testing Souris and Red River reservoir horizons

· High grade helium assayed at 1.1% helium with the balance being primarily nitrogen

· Commercial flow rates sustained at 2,750 thousand cubic feet per day (Mcf/d) of raw gas at 40/64" choke with Absolute Open Flow calculated to be over 4,500 Mcf/d

Helium Recovery & Purification Plant

As per March 27, 2025 Press Release (paraphrased):
Fabrication work commenced on a helium membrane package for delivery ahead of production in summer 2025

Helix Exploration's Rudyard Field on tract to be the First Commercial Helium Production in Montana!!

Many Questions to be Answered?

- Which rocks within the Pre-Cambrian terrains are generating the Helium? How deep?
- Are there possible reservoirs within the Pre-Cambrian?
- How far does the He^2 migrate horizontally in Montana?
- How can you identify effective seals in overlying reservoirs?

I know if I'm looking for He^2 , I'm working Montana!

HELIX EXPLORATION
IS LOOKING FOR HELIUM
OPPORTUNITIES IN MONTANA!!

Contact:
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Bo@helixexploration.com

References used in the preparation of this presentation may be obtained by contacting: **Robert H. Springer** at springerresources@gmail.com or 817-228-7730